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SIMPLE GOITER

BY

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A DISSERTATION

Submitted in Partial Fulfillment of the Requirements
For the Degree of
Doctor of Public Health,
in
The University of Michigan.

June, 1925

PREFACE

The purpose of this dissertation is (1) to review briefly the literature on simple goiter, (2) to point out the incidence and distribution of simple goiter as determined by recent surveys, (3) to tabulate the present activities of the various states in the prevention of goiter, and (4) to suggest a plan for the prevention of goiter on a large scale. The first of these divisions, concerned with the literature, is covered in part one, the second, third and fourth in part two.

The subject of simple goiter becomes a proper matter for public health consideration because of its enormous incidence as shown by recent studies, and because of the practicability of its control by general measures.

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PART I

GENERAL CONSIDERATIONS

What is a Goiter

According to Dorland (20) goiter is "an enlargement of the thyroid body, causing a swelling in the front part of the neck." Stedman (86) amplifies this definition by stating that goiter is "a chronic enlargement of the thyroid gland, not due to a neoplasm, occurring endemically in certain localities, especially mountainous regions, and sporadically elsewhere."

Hunziker (34) has pointed out that the size of the normal thyroid gland is not known, and for that reason no one can state where the normal thyroid gland stops and goiter begins. Even when the normal adult size is theoretically established, the normal adult sizes at different ages in various parts of the world are not known.

Plummer (76) states "no definite boundary line between the normmal and excessive storage of colloid can be pointed out. Storage to the degree of making the human thyroid easily palpable is generally accepted as abnormal." On the other hand, Boothby (8) points out that "slight, temporary enlargement of the thyroid gland occasionally occurs in young people of both sexes in regions where goiters are endemic. The enlargement is symmetrical and soft and appears to accompany periods of stress. It is not infrequently of periodic character, being prone to occur at the beginning of menstruation and during pregnancy. The changes in size here referred to are slight and not, as a rule, beyond the limits of possible physiologic variation."

Marine and Kimball (54) states "simple goiter includes all those thyroid enlargements in man and animals formerly grouped as endemic, epidemic, sporadic and physiologic. It must be sharply distinguished from exophthalmic goiter, with which it has no necessary association or etiologic relationship. Exophthalmic goiter, so far as is yet definitely known, occurs spontaneously only in man, while simple goiter occurs in all animals having the ductless thyroid. Exophthalmic goiter is not notably associated with districts, while with simple goiter this is most characteristic." More recently Marine (53) has defined simple goiter as "a compensatory hypertrophy of the thyroid gland developing during the course of metabolic disturbances

of unknown nature but depending immediately on a relative or absolute deficiency of iodin."

In the light of these opinions it is apparent there can be no hard and fast division between the normal and goitrous thyroid. It also is to be noted that the use of the word goiter has been discarded by many workers and the term "thyroid enlargement" used in its place. In the minds of many people goiter is associated with disfigurement, prolonged suffering or a mutilating operation while the use of the term thyroid enlargement tends to allay any such feeling.

Methods of Determining Extent of Thyroid Enlargement

In determining the extent of thyroid enlargement considerable practice as well as judgment is required. When the involvement is pronounced, there is no difficulty in classifying the relative degree of increase in accordance with established standards. When the involvement is relatively slight, however, it is often difficult to judge the matter accurately. Many methods of procedure have been used by goiter survey workers and some of the most common are reviewed here.

Hertzler (31) states that "ordinarily in average necks the normal thyroid gland is just palpable to experienced hands. If easily palpable, it is probably slightly enlarged. If palpable in a plump patient, it may be regarded as being enlarged. Often an increase in consistency is as valuable as evidence as increase in volume. Increase of sensitiveness, likewise, may be evidence of increased activity. During pregnancy these statements must be modified, for during this state not infrequently the thyroid gland is easily palpable in the normal state." Cabot (14) maintains that the normal thyroid can rarely be felt.

The following procedure is suggested by Boothby (8). "To palpate the thyroid, grasp the right lobe with the left hand, thumb proaching from behind the posterior border of the sternocleidomastoid muscle. By this method the anterior-posterior diameter can be quite accurately estimated and, by moving the hand up and down, the length of the gland can be determined. If an adenoma is present, it may frequently be sufficiently elevated out of the thoracic strait by instructing the patient to swallow so that the thumb and fingers can be slipped in beneath the tumor. The examination is facilitated by pressure of the

other hand on the opposite side, pushing the gland and trachea towards the side being palpated."

The method used by Oleson (66) in the Cincinnati survey is described by him as follows: "it was the practice to view the side of the neck of each child in a good light. If the neck line was straight and the fullness peculiar to slight isthmiol thickening was lacking, thyroid enlargement was presumably judged to be absent. However, before a final decision was made, the region of the usual isthmiol location, namely, across the second and third, and occasionally, the fourth ring of the trachea, was palpated by approximating the palmar surface of the middle finger. By a gentle up-and-down movement the isthmus can usually be felt and a decision made as to whether the thickening is sufficiently great to be recorded. With the finger still in position the child is asked to swallow, thereby causing the isthmus to be brought into bold relief beneath the finger. In very many instances the extent of isthmiol enlargement may be determined by simple observation of the neck while the child swallows."

In order that the survey observations of different workers be comparable, definite standards must be used. The standards adopted during thyroid surveys have usually been those used by Marine and Kimball (55) in their investigations in Akron, Ohio. These authorities divided the thyroid enlargements observed by them into three groups namely "slight", "moderate" and "marked". Oleson (66) has suggested the desirability of a finer classification in order to compare the size of the goiter at the time of one survey with the size observed at a subsequent one. The terms used by him in the Cincinnati survey were "very slight", "slight", "moderate", "marked", and "very marked".

The Relation of Age, Sex, Race and Season to Thyroid Enlargement

Age.—Goiter may develop at any age, though its incidence is least during the first years of life. Janney (35) maintains that goiter incidence gradually increases to the fourth decennium, then decreases. Marine (48) says "simple or endemic goiter most commonly develops (1) during fetal life (2) during adolescence, and (3) during pregnancy and lactation. The greatest number of goiters develop around the age of puberty."

Most of the recent goiter survey work has been conducted

in the schools and for that reason the results of two very recent surveys are given here to indicate the age incidence of goiter. Oleson and Clark (69) examined 4,061 children between the ages of 5 and 23 years. They found that the incidence of goiter among girls increases up to 14 years of age and thereafter remains fairly constant up to 17 years of age. Among the boys it was found that the incidence of goiter increases up to about the eleventh year of age and remains fairly constant until about the fourteenth year of age and then declines rapidly until the seventeenth year of age. Foard (26) in a Montana survey has obtained the following results: among the grade school girls 24 per cent at 6 years of age to 83 per cent at 16 years of age, and 20 per cent among boys at 6 years of age to 34 per cent among boys at 13 years of age. Among high school students the maximum goiter prevalence among girls was 58 per cent at 18 years of age and among boys 38 per cent at 17 years of age.

Sex.—During early childhood the incidence of goiter is about equal among boys and girls. From puberty onward, however, the female sex is most often affected. Kimball (39) concluded after his work in Akron, Ohio, which was with the higher grades, that goiter was at least six times more frequent in girls than in boys. Later, however, when surveys included children in the lower grades, Kimball (40) found that the condition was only two or three times more frequent in girls than in boys. Recent surveys indicate that the ratio of thyroid enlargement among boys and girls is subject to considerable variation. The recently completed examination of all school children in Grand Rapids, Michigan, for instance, showed that only twice as many girls have thyroid enlargement (80). In Cincinnati, Ohio, Oleson (66) obtained a ratio of six to four in several of the schools. In a Minnesota survey Oleson and Clark (69) found the rate for slight goiter among girls to be 1.3 times the rate for boys, but the rate for moderate goiter among girls was 3.9 and for marked goiter 6.3 times the rate among boys.

Janney (35) in discussing sex and goiter incidence makes the following interesting statement: "Puberty and gestation predispose to goiter. During pregnancy goiters may greatly enlarge, declining again in size thereafter. Pregnancy in normal women is, however, known to cause thyroid hypertrophy in a number of cases, even menstruation may cause thyroid swelling."

Race.—All races may be affected. Janney (35) maintains that the apparent greater incidence at times noted among members of a given race in a given country is due to other causes. Oleson (66) has shown that there is no racial immunity to goiter among colored children. In the Cincinnati survey he found 26.4 per cent of the white boys and 28.2 per cent of the colored boys to be affected, while 39.0 per cent of the white girls and 45.1 per cent of the colored girls were found to have enlarged thyroids. Hrdlicka (89) has called attention to the prevalence of goiter in certain Indian tribes, notably the Cheyenne River and Ft. Yates Sioux.

Season.—According to investigations of Seidell and Fenger (82) the iodin content of the thyroid is lowest during the first four months of the year. It is then that goiters reach their maximal size by a process of compensatory hypertrophy. Janney (35) states "outbreaks of 'spring' or 'summer' goiter are not uncommon among new-comers in European endemic centers. They may be possibly due to contamination of the water supply by the spring rains or to a low spring and summer iodin content of the affected thyroids. In animals seasonal variation in goiters has been traced to the low iodin content of food at certain seasons. In countries of dry and rainy seasons the disease is more prevalent during the wet period owing to contamination of the water supply by surface water." Recently Von Fellenberg (25) has noted a distinct seasonal variation in the iodin content of river water and he points out its close relationship to thyroid enlargement.

Simple Goiter and Mentality

Many writers attribute mental subnormality and actual deficiency to endemic or simple goiter. Marine (48) in discussing this says: "The prevention of simple goiter means vastly more than preserving the normal outlines of the neck. It means in addition the control of those forms of physical and mental degeneration, such as cretinism, mutism and idiocy, which are dependent upon thyroid insufficiency." Recently Olin (70) has reported a definite relation between goiter and backwardness in school. Clark (16) and Oleson (66) suggest the need for more authentic information on the relationship of endemic goiter to mentality. The United States Public Health Service is conducting such an investigation at the present time.

Basal Metabolism and Thyroid Enlargement

The study of basal metabolism has received a great impetus, and its importance in connection with the diagnosis and treatment of goiter is becoming more generally recognized. The determination of the body basal metabolic rate is a determination of the heat production of the body under standard conditions. Boothby (9) has shown that the basal metabolic rate differentiates diseases into those have increased, normal, or decreased basal metabolism quite as sharply and constantly as does temperature into febrile and afebrile groups. The "normal" line, however, of the basal metabolic rate is somewhat arbitrary and varies with age. There is considerable difference between the normal for a child and an adult. The usually accepted normal rates in healthy individuals vary from 10 below to 10 above this "normal" line. Most symptoms of hyperthyroidism are due to secondary effects on the body of long continued and marked increase in the basal metabolism. In hypothyroidism the symptoms are due to a decrceased basal metabolism.

In 1895 Magnus-Levy (47) noted a reduction in gaseous metabolism in cretinism and myxdema and an increase in metobolism in hyperthyroidism. His work has been confirmed by Du Bois (21), Plummer (76), Means and Aub (62) (63). The basal metabolic rate in cretinism and myxedema varies with the severity of the cases and is depressed to as low a level as 40 per cent to 50 per cent in the severest instances. In the case of colloid goiter Boothby and Sandiford (13) found 81 per cent within plus or minus 10, 9 per cent being above +10 and the remaining 10 per cent below —10.

According to Du Bois (22) metabolism is low at birth, increases rapidly during the first year of life, reaches its maximum between 1 and 6, falls quite rapidly until the age of 20, then very slowly. During infancy there is no apparent difference between the sexes, but after the age of 6 girls and women have a distinctly lower metabolism than boys and men, averaging 6.2 per cent lower. In this connection the results obtained by Oleson (66) are significant. He states "Thyroid incidence progressively increases among girls between the ages of 6 and 16 (remaining practically the same, however, at age 13, 14 and 15). With boys the increase is steady, though constantly less than among girls, until the age of 13 is reached, after which age there

thyroid enlargement among girls is also evident at this age and should be considered in connection with the basal metabolic rates, which are lower in girls than in boys. While the basal metabolic rates are not materially disturbed in the presence of endemic goiter, the normal variation being within plus or minus 10 per cent, it is evident that basal metabolism bears a rather definite and constant relation to the condition."

The Relation of Iodin to the Thyroid Gland

That iodin exerted a definite influence upon the thyroid gland has been known for a long time. As early as the twelfth century, goitrous enlargements of the thyroid were treated with iodin containing sponges and seaweeds by Roger of Palermo at the Medical School of Salerno. In 1895 Baumann (2), (3), discovered the presence of iodin in the thyroid gland, and prepared a substance from it containing 9.3 per cent of iodin. The substance is known as thyroidin. Ever since this discovery the chemistry of the gland has centered around the iodin-containing compound. In 1899 Oswald (73), (74) obtained a globulin from the gland which he named thyreoglobulin. The iodin content of this product is slightly higher than that of the dessicated thyroid, and clinicians and physiologists agree that thyreoglobulin possesses the entire activity of the thyroid (78).

More recently Kendall (37) (38) has isolated a white crystalline substance from the thyroid gland which he calls thyroxin. The iodin content of which was found to be 65 per cent. This substance has been analysed and synthetically prepared by Kendall, and its structural formula has been shown to be 3, 5, 6 trihydro, 4, 5, 6 tri-iodo, 2 oxy, 3 indol propionic acid. This substance is stated to possess the active properties of thyroid gland extracts and substances. According to Plummer (77) 1 milligram of thyroxin in an adult weighing 150 pounds increases the metabolic rate 2 per cent. Plummer and Boothby (78) state that "the chief value of the active principle of the thyroid gland in clinical medicine lies in the treatment of true myxedema and cretinism, because these diseases are due to the inability of the thyroid gland to form sufficient thyroxin to maintain the concentration of thyroxin in the tissues at the normal level." Marine (49) (50) has shown that a thyroid which contains less than 0.1 per cent of iodin cannot be normal anatomically, and a thyroid that has continuously had an iodin store above 0.1 per

cent cannot be abnormal anatomically. Marine and Lenhart (56) (57) have demonstrated that the addition of a small amount of iodin to the water in the fish hatchery tanks freed the fish from goiter.

Recently the prevention of goiter on a large scale in the schools has been accomplished by Marine and Kimball (55) by the use of 0.2 to 0.4 grams of sodium iodid daily. The results may be quoted as follows: "Not a single pupil in whom the thyroid was normal last year and who took iodin, showed any enlargement, while of those not taking iodin, 26 per cent showed definitely enlarged thyroids—some moderately large goiters. Even more than a prophylactic action is shown in the results—just one third of the goiters marked "small goiters" disappeared; and one third of those marked moderate goiters showed a decrease of 2 cm. or more. Accordingly a distinct therapeutic effect is clearly demonstrated."

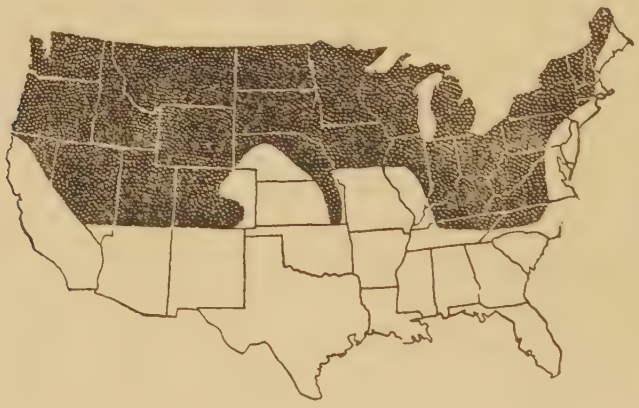

FIG. 1.—The iodin in drinking water in the United States: In the black area, waters contain from 1 to 22 parts of iodin per hundred billion parts of water; in the white area, from 23 to 18,470 parts. Some old analyses have shown even higher values in mineral springs in the southern half of California.

During a recent survey by McClendon (60) the water of a number of the representative rivers of the country was analysed for iodin. A map of the United States, prepared by him shows that the country can be divided into more or less definite regions as regards iodin distribution, and that these regions coincide with the known goiter areas. McClendon and Hatha-

FIG. 2.—Simple goiter in the United States, from data of the Draft Board: In the white area there were from 0 to 5 military goiters per thousand drafted men; in the black area, from 5 to 111. The military goiter was defined as one too large to button a military collar around. In the region outlined below by the dotted line, and marked "Permain Salt Deposits," an arm of the sea was cut off from the Pacific Ocean by the upheaval of the Rocky Mountains during the geologic age known as the Permian period. Its evaporation left extensive salt beds, which have stratified owing to different solubilities of the salts, as shown by gypsum deposits, rock salt and deposits high in potash (in western Texas). In very dry regions, this material may reach the surface (perhaps secondarily), as shown by the potash lakes of western Texas. In moist regions, all the surface salts are washed away and the deposits are reached only in drilling deep wells. The iodin that was in the sea water is mixed up more or less with the other salts; some of it apparently reaches the food and drink of mankind to make this a low goiter region. It should be noted that the black and white areas correspond roughly to those of Figure 1, the most striking difference being that of New York State. If, however, we had included the waters of Lake Erie and Lake Ontario, which are high in iodin, and excluded the waters from mountain sources, in making Figure 1, the two areas would have corresponded.

way (60) believe that they have proved statistically that both simple and exophthalmic goiter in the United States are caused by iodin starvation. They present the results of their analysis of foods from goitrous (Minnesota and Oregon) and non-goitrous (New England and California) regions. In the non-goitrous regions the iodin content may be 100 per cent higher than in the goitrous regions. The work of McClendon parallels the work

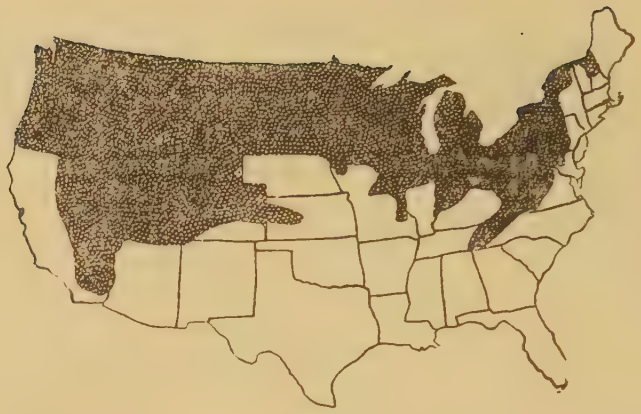

FIG. 3.—Exopthalmic goiter in the United States, compiled from Draft Board statistics: In the white area, from 0 to 2.85 per thousand drafted men were reported as having exophthalmic goiter; in the black area, from 2.85 to 93. It should be noted that the black and white areas correspond roughly to those of Figures 1 and 2, except for the edges of contact; but owing to the fact that there is considerable migration of the population, this is to be expected.

of Fellenberg (25) in Switzerland, in 1923, who showed that in his country the percentage of iodin in the water in different localities was in inverse ratio to the prevalence of goiter. The same relationship has been noted by Eldrige (24) in making a detailed study of the water supplies of Michigan.

Iodin Requirements of the Thyroid Gland

According to Kimball (39) "the normal thyroid contains about 5 milligrams of iodin per gram of dried gland, 25 to 30 milligrams being the storage capacity. Therefore, the administration of a few milligrams of iodin daily over a period of 30 or more days will supply the deficiency, which, in a large part, is responsible for the enlargement of the thyroid. The gland will start to enlarge as soon as the iodin content falls below one-tenth of 1 per cent of the total amount of dried gland tissue."

Methods and Forms of Iodin Administration

Iodin is readily taken up by the thyroid when administered by inhalation, by external application or by the mouth. All of

these methods have been used and apparently with success. The most common method, however, is that of administering the iodin by mouth.

Inhalation.—Weith (92) reports favorable therapeutic results from the inhalation of iodin secured by the suspension in the school room of a wide-mouthed bottle containing 10 per cent tincture of iodin. This method, because of its variability and difficulty of accurate dosage, is seldom used as a prophylactic measure.

External Application.—This method is used in the treatment of simple goiter and also at times for prophylactic purposes. Painting with iodin should be entirely discarded, according to Crotti (18). This form of iodin application blisters the skin and soon prevents the continuation of the treatment. It is a therapeutic measure which possesses no particular advantage and should be supplanted by one of the more readily applicable and efficacious methods.

Internal Administration.—The first extensive goiter prophylaxis was that instituted by Marine and Kimball (55) in Akron, Ohio. They used 3 grain doses of sodium iodid given in the drinking water once each day for two weeks each spring and fall. This dosage they state has prevented enlargement of the thyroid in more than 99 per cent of the children of that district. The disagreeable taste, however, of sodium iodid is held as an objection to its use.

The iodin chocolate tablet suggested by the Swiss has become very popular. Instead of sodium iodid, an organic iodid which is practically tasteless and very stable, is combined with chocolate in tablet form. Each tablet contains between 5 and 10 milligrams of iodin. One tablet is given each week through the school year to the children in need of the prophylaxis. This method was used with much success by Klinger (42) in Zurish, Switzerland. It has also been employed in all the schools of the Cantons of St. Gall, Berne, and Zurich for more than three years. The Goiter Commission of Switzerland has recently recommended that this method of goiter prevention be instituted as a public health measure throughout the entire country. Kimball (40) in a recent paper recommends the chocolate-iodin tablet as the most acceptable form for individual oral prophylaxis.

Iodized Drinking Water.—Rochester, N. Y. (5) has recently adopted the method of adding iodin to the drinking water to

prevent goiter. The plan of this city is to iodize the entire supply of drinking water twice each year for a period of two weeks. The Iodin content of the water being carefully checked by the laboratory. This method is new and has many possibilities.

In commenting upon the Rochester plan the Weekly Bulletin of Chicago health department (15) estimates that the consumption of 2 quarts per day of treated water during the two periods will provide sufficient iodin to prevent endemic goiter in accordance with the present Swiss standard, which is fixed at 1/150 of a grain of iodin. The Bulletin points out the enormous waste occasioned by the treatment of the entire water supply. It also points out that the success of the plan depends upon the daily consumption of at least two quarts of water by each individual.

Iodized Salt.—Sloan (84), following Marine's suggestion for animals, advocates an iodized salt for the use of human beings. He calls attention to the fact that, next to water common salt is the most universally used article of food. He has also shown that in the evaporation of salt brines the mother liquor which is removed takes with it the natural content of iodin. Both Forbes and Beegle (27) and Bohn (7) report the entire absence of iodin in various forms of market salt examined. Hence, salt as it comes to the table cannot be utilized for goiter prophylaxis without the artificial addition of iodin. Hayhurst (30) expresses the opinion that salt should contain sodium iodid and other compounds associated with sodium chloride in sea water. Salt for dietary purposes he believes, should be prepared from sea water or from inland sources known to contain sodium iodid or other desirable compounds. Practically all the salt used in the United States according to the U. S. Geological Survey Report (75) is from inland sources which are, in the main, inherently free from iodin.

The use of iodized salt as a goiter prophylactic has been recognized by Bayard (4) of Zermott, Switzerland. He gave a mixture of common salt and iodin to five goitrous families daily for five months. A little later he extended his experiments to include two small villages, the iodization lasting six months. Each kilogram of salt used contained 0.004 gram of potassium iodid. This was continued in one of the villages for another year, except the iodin being increased to 0.01 gram for each kilogram of salt during the first six months and again increased to 0.02 in the next six months. Excellent results are claimed by Bayard

for this method of administering iodin. He is convinced that the addition of 20 milligrams of potassium iodid to each 5 kilograms of table salt, a year's consumption, is ample to prevent the development of goiter and to cause the regression of visible goiters in school children. Bayard urges the compulsory iodization of all salt to the extent of 0.5 milligrams of potassium iodid per kilogram of salt at first and, gradually increasing the amount to 2 milligrams per kilogram.

The use of iodized table salt introduced into the Canton of Vaud in 1922 has, according to Eggenberger (23) given most encouraging results. Mothers who keep on using the old pure salt have, as before, about 50 per cent of babies with enlarged thyroids. The new born children of those who use iodized salt have normal thyroids. He never saw injury from doses of iodin lower than 20 mg. per month.

Wagner-Jauregg (90) at a meeting of the Vienna Medical Society in February 1923, strongly urged the use of salt containing 0.004 milligrams of iodin to each kilogram of salt in Styria, a well defined goiter district in Austria. He states that there is no danger of causing ill effects by the use of such doses of iodin. Analysis of samples of salt from various sources show that iodin is present in large amounts from some sections and low or absent from other regions. In Bordeaux, France, for instance, the salt contains three times the quantity of iodin contained in the salt used in the experiments of Bayard, no ill effects being discernible following its constant use. A recent investigation by Rosenbluth (81) shows that the iodized salt (0.005 gm. potassium iodid per kilogram of sodium Chloride) is rapidly supplanting the pure salt in Austrian households.

Iodized salt is advocated by Hirrchfelder (33) for prophylaxis and for therapy. He gives specific directions for preparing iodized table salt for general as well as home use. Oleson (66) favors the enactment of a Federal statue requiring the iodization of all table salt sold in the United States. He states "that it would insure uniformity of the product and would restore to common salt one of the important ingredients which, when naturally present is invariably removed in the process of refining." It is to be noted that several of the states at the present time favor the use of iodized salt.

Possible Ill Effects of Iodin Prophylaxis

Most physicians, at the present time, agree that there is little possibility of producing ill effects by iodin prophylaxis. There are some writers, however, notably Kocher (43) (44) Quervain (79) and Birchner (6) who maintain that harm may result from the prolonged use of iodin. Kimball (41) however maintains that the possibility of harm from the dosage of iodin recommended by him is absolutely negligible. In the Akron schools a mild rash was encountered in only one per thousand of the cases treated.

It has been demonstrated by Plummer (10) "that many of the most outstanding and characteristic symptoms of exophthalmic goiter disappear rapidly and with a high degree of regularity following the administration of iodin." On the other hand (28) it has been shown that basal metabolism might be increased when iodin is administered in sufficient quantity to patients with adenomatous goiter. This is undoubtedly due to the conversion of the adenomatous goiter without hyperfunction into the condition designated by Plummer as adenomatous goiter with hyper-function. Boothby (11) (12) believes that adenomatous, as well as simple goiter, may be prevented by the proper administration of iodin. He warns, however, against attempts to reduce existing adenomatous enlargements, because such tissue may be excited to hyperfunction through iodin therapy. A recent statement by Marrine (53) is of special interest he states, "it is certain that the dangers of initiating Graves disease by the use of iodin have been exaggerated and most, if not all, instances have been due to gross abuse of iodin or dessicated thyroid alone or combined."

The opinion expressed by an editorial in the Journal of the American Medical Association, December 6, 1924 is of special interest. "It seems unlikely, from what has been observed that benign thyroid enlargements are frequently converted into toxic goiters by the administration of iodin; and there is a growing belief that even toxic goiter may be sometimes benefitted by the element."

PART II

Geographic Distribution of Simple Goiter

Goiter is very generally distributed throughout the entire world, but the incidence of endemicity varies greatly. Some localities in which the incidence of goiter is so extremely high have been known for years as goiter districts. The best known of these districts is that comprising southeastern France, southern Germany, Switzerland, Southern Austria and northern Italy. In 1874 the Goiter Commission of France estimated that in that country there were 500,000 persons with goiter. Kocher cited by Kimball (41) has shown that 80 to 90 per cent of the school children of Berne were goitrous. Klinger (42) states that in some of the schools of Zurich, where he was working, 100 per cent of the children were goitrous. In Italy from 1859 to 1864, according to McCarrison, 3 per cent of the conscripts were excused from service on account of this affection.

In Asia practically all of the Himalaya district is a goiter belt, with a high incidence in northern India and parts of western China and eastern Mongolia according to the work of McCarrison (58). He states that in some of the villages of Himalayan India it is difficult to find a man, woman or child who is not suffering from the deformity. McCarrison's observations were made in the Gilgit region of the Indian Himalaya Mountains. In a population of 70,000 persons, 20 per cent were found to have goiter, and of these, 200 were cretins. Likewise Hirsch (32) cited by Vaughan (89), has pointed out the presence of goiter in South America, (Andes region especially), Central America, the West and East Indies, Siberia, Finland and far north in Canada. In North America goiter is endemic in the whole of the Great Lakes' basin, the St. Lawrence basin and in the northwestern part of the United States.

It is to be noted that in each of these large goiter regions there are localities in which the incidence of goiter is much higher than the surrounding territory. This is due to the difference in the iodin content of the water and food supplies of the various localities. In mountain regions, for example, many communities pipe the water from the mountain springs, low in iodin, while others depend upon deep wells for their water supply. Wallace (91) has pointed out the lower incidence of goiter

in rural communities using shallow and deep wells, and the higher goiter incidence in nearby communities piping the water from the mountains. In one school district where piped mountain water was used, he found 83.5 per cent having enlarged thyroids, while in a nearby school using well water only 6 per cent were goitrous. Olin (70), has also noted a great difference in the percentages of goiter in the various cities and counties of Michigan. Another outstanding example of this is that reported by McCarrison (59), in the Gilgit District in India. Here eight villages adjacent to each other derive their water from a neighboring stream, and all are badly affected with goiter. Another village in the same district takes its water from a spring and has no goiter.

The relative infrequency of goiter along sea coasts and its mild type when present is mentioned by Hayhurst (30). It is especially brought out in "Defects Found in Drafted Men" (88), in which the ratio stands as 1.02 to 17.55 when sea coast dwellers are compared to dwellers in mountain regions. It should not be inferred from this, however, that all mountainous regions are goitrous, and valleys and plains non-goitrous. There are exceptions to this as pointed out by Vaughan (89), "while endemic goiter is more prevalent at high altitudes, it is by no means unknown in low-lying valleys and on alluvial plains. All highlands do not harbor this disease, it being unknown in the mountains of Scandinavia and in the highlands of Scotland."

In North America goiter areas have been known for many years. In 1800 Barton (1) wrote a monograph on the occurrence of goiter among the Indians living along the shores of Lakes Ontario and Erie. Munson (65) described goiter among the Indian tribes of the Rocky Mountain region. Dock (19) has pointed out the frequency of goiter in Ontario, and Marine in the Great Lakes Region. Shepherd (83) in 1918 stated that the incidence of goiter was very high in British Columbia and Alberta and that in some localities most of the domestic animals were affected.

Incidence of Simple Goiter in the United States

Many efforts have been made to determine the prevalence of goiter in different sections of the country. Not until the entrance of the United States into the World War, however, had any extensive survey been made. Of the surveys made before 1918, the following are the most important. In 1913 Clark (17) examined 13,836 school children in 11 counties of West Virginia and found 1,234 cases of goiter, or 8.91 per cent. He also examined 6,432 school children in 9 counties of Virginia and found 817 cases of goiter or 12.7 per cent of the number examined. In 1914 Hall (29) examined 3,339 students at the University of the State of Washington with reference to goiter. He found enlarged thyroids in 17.93 per cent of 2086 men whose average age was twenty years and five months, and in 30.98 per cent of the 1253 women examined, whose average age was nineteen years and three months. Olsen (72) found among 606 women in Chicago 17.87 per cent with goiter. Marine and Kimball (55) in 1916 examined 3872 girls from the fifth to the twelfth grades inclusive, of the public schools in Akron, Ohio. They found 43.59 per cent having normal thyroids, 49.88 per cent had slightly enlarged thyroids, in 6.35 per cent there was a moderate enlargement, in .18 per cent a marked enlargement and in 1.01 per cent the gland was adenomatous. These figures are indicative of the incidence of goiter in these particular regions.

During 1917 and 1918 when so many of our young men were being examined for war service, an opportunity was offered to determine the incidence of goiter among young men and to compare the incidence of goiter in different sections of the country. It has been generally found where goiter prevails that the number of cases among females is much greater than that among males, and still the records of draft boards show that nearly one per cent of the young men examined were unfit for military service on account of goiter. The draft records show that the goitrous men come from certain definite sections of the country, being most common in the northwestern part of the United States, including the states of Washington, Oregon, Idaho, Montana, Utah and Wyoming. Wisconsin and Michigan also show high goiter rates. It is the least frequent in the southern states. This is especially well shown in the following

table prepared by the War Department in 1920, based on the defects found in the drafted men.

TABLE I—Grand total for goiter, simple, with ratio per 1,000 men

State	No. of cases	Ratio per 1,000	State	No. of cases	Ratio per 1,000
Idaho	336	26.91	North Carolina	100	1.81
Oregon	421	26.31	Kentucky	90	1.41
Washington	832	23.40	District of Columbia	16	1.39
Montana	576	21.00	Kansas	48	1.25
Utah	185	15.72	Arizona	10	1.21
Wyoming	102	15.37	New York	308	1.19
Wisconsin	886	14.02	Maryland	35	.94
Alaska	16	13.14	South Carolina	37	.94
Michigan	1131	11.43	Connecticut	32	.89
North Dakota	156	8.73	New Mexico	9	.88
Minnesota	578	8.04	Oklahoma	44	.72
West Virginia	307	7.89	New Hampshire	6	.70
Illinois	1397	7.79	Maine	13	.66
Iowa	458	6.68	Mississippi	24	.64
Indiana	464	6.49	Louisiana	32	.62
Nevada	21	6.38	Delaware	3	.59
Ohio	798	5.59	Alabama	29	.56
Colorado	119	5.29	Rhode Island	8	.55
California	359	4.45	Georgia	33	.52
Pennsylvania	829	4.10	New Jersey	33	.43
South Dakota	85	4.09	Arkansas	17	.40
Missouri	342	3.99	Massachusetts	29	.32
Virginia	188	3.38	Texas	36	.30
Nebraska	63	2.14	Florida	6	.25
Vermont	18	2.14	State not specified	186	1.96
Tennessee	120	1.96	Total	11971	4.35

Since the publication of the Army Draft Record in 1920, a large number of the states have undertaken goiter surveys, either of a local or state wide character.

Practically all of these surveys have been or are being made in connection with the schools and complete figures in most places are not yet available. Of those that are available, the following are given as being indicative of the incidence of goiter in the various sections:

TABLE II.—Some recent goiter surveys made in the United States

Locality	Total No. Examined	Percentage found to have goiter		
		Males	Females	Total
Colorado (68)				
Denver pub. schools	9,656		27.3	27.3
Colorado Springs	1,699	38.2	44.6	41.4
8 Localities	2,709	26.5	37.9	32.2
39 Localities	3,274	10.1	23.3	16.7
Olathe	99	51.9	72.3	62.1
Grand County	210	0.0	0.0	0.0
Indiana (46)	All Fr. girls at Univ. of Indiana		41.0	41.0
Michigan				
Grand Rapids (80)	26.215	32.7	67.3	50.0
Macomb County (70)	10,258	20.1	32.0	26.0
Midland County	3,645	24.4	41.1	32.7
Wexford County	3,984	47.6	63.4	55.6
Houghton County	13.725	41.9	70.5	64.4
Minnesota (69)				
13 Localities	4,061	40.9	71.0	57.9
Montana (26)				
7 Counties	13,937			21.6
Ohio (66)				
Cincinnati	47,493	26.6	39.8	33.2
Utah (91)				
Grade and High Schools	69,256	31.0	54.3	42.7
Univ. Students	1,945	31.2	56.6	42.9
Virginia (17)				
9 Counties	6,432			12.7
Washington (29)				
Grade pupils	3.339			26.4
West Virginia				
11 Counties	13,836			8.91

Present Status of Goiter Prevention in the United States

The prevention of simple goiter is proving to be one of the most interesting and practical problems of preventive medicine. Since it has been demonstrated that endemic goiter is an iodin deficiency disease, there has been a steadily increasing interest on the part of public health officials, physicians, and the laity in the practical application of this knowledge. The prophylactic measures instituted by Marine and Kimball (55) in 1916 have yielded such results as to lead to their statement, "simple goiter is probably the easiest of all known diseases to prevent." Since their work in the Akron schools, many other states in which goiter is endemic, have adopted the prevention of goiter as a public health measure. The following tabulation shows the goiter activities of the various states (85).

State	Goiter Surveys	Prevention
Alabama	No state or local surveys have been undertaken.	None
Arizona	State wide survey anticipated, no surveys have been made yet.	None
Arkansas	Surveys have been made in a few communiites. Goiter reported as not being prevalent.	None
California	A few local surveys have been completed.	No state control
Colorado	Several community surveys have been made, mostly in connection with schools.	No state control, some communities are using iodin tablets.
Connecticut	No state or local surveys have been made.	None
Delaware	No surveys.	None
Florida	No surveys have been undertaken.	None
Georgia	A few purely local surveys have been made. Goiter reported not prevalent.	None
Idaho	Several local surveys have been completed. Plans for a state wide survey being formulated.	None

State	Goiter Surveys	Prevention
Illinois	Several surveys completed.	.....
Indiana	Local surveys in a few schools also at Indiana University.	Educational work and goiter pamphlet published by State Board of Health.
Iowa	A few purely local surveys have been made.	Publication of goiter pamphlet and educational work.
Kansas	Six scattered counties and two large cities are being surveyed. Goiter is reported not prevalent.	No state control at present.
Kentucky	A few local surveys.	State Board of Health urges use of iodin in schools. Pamphlet urging use of iodized salt.
Louisiana	A few school surveys have been completed, and quite a number of goitrous children found.	None
Maine	A state survey has not been undertaken. A tentative survey in a part of Aroostook County has been made.	None
Maryland	A survey of Allegany County and a few of the larger towns of the state has been completed.	State at large is doing nothing. Some towns are recommending use of iodized salt.
Massachusetts	No survey at present. Goiter survey of schools of state being considered.	None
Michigan	State wide survey has been undertaken.	State wide use of iodized salt is advocated.
Minnesota	Several local surveys have been made by State Board of Health and the U. S. Public Health Service.	No report.
Mississippi	No report.	No report.
Missouri	No surveys have been made by the state.	None
Montana	Several local surveys have been compiled recently. The public health nurses of the state are making a complete survey at present.	Iodized salt is advocated by the State Board of Health.

State	Goiter Surveys	Prevention
Nebraska	No surveys	None
Nevada	No surveys	None
New Hampshire	No surveys	A goiter pamphlet has been published and educational work is carried on by State Board of Health.
New Jersey	A few purely local surveys have been made. At present a large city is being surveyed for goiter. Goiter is reported as not being prevalent.	None
New Mexico	No surveys have been made, "very little goiter is found."	None
New York	School survey 75-80% complete. Carrarangus County also many cities, towns and villages have made complete goiter surveys.	Rochester-Sodium Iodid in water supply. Syracuse-proprietory tablets of organic iodin. Clean-Sodium iodid being given to school children. Various other places — same.
North Carolina	A few local surveys have been made, "goiter not prevalent.	None
North Dakota	State survey planned for 1925.	No state effort is being made. A few cities undertaking prevention.
Ohio	Many local surveys complete including cities of Akron, Hudson, Cleveland and Cincinnati.	State department advises communities to undertake goiter surveys and urges use of iodin by any of the various methods.
Oklahoma	No surveys have been made.	None
Oregon	No general survey, several schools have been surveyed for goiter incidence.	State Board of Health recommends the use of iodized salt. Chocolate iodin tablets are being used by some schools.
Pennsylvania	No state survey has been made. State wide inquiry at present being conducted.	None by the State Board of Health.
Rhode Island	No surveys have been made.	Nothin is being done in prevention.

State	Goiter Surveys	Prevention
South Carolina	No surveys have been made. Goiter is reported as not being prevalent.	None
South Dakota	No survey has been made.	Free distribution of iodin preparation by the state.
Tennessee	No surveys have been undertaken. Goiter incidence of the state is low.	None
Texas	No surveys have been made. Reported as "not a health menace here."	None
Utah	A state wide survey has been undertaken and 75 per cent of the school population examined.	Iodin-chocolate tablets given to school children.
Vermont	No state survey has been made. Several cities have made surveys and much interest in goiter is reported in Vermont.	No organized state effort yet.
Virginia	A survey by correspondence with Doctors of the State. Its prevalence and distribution is thus known.	A circular letter by state Board of Health urging use of iodized salt.
Washington	Most of the state including larger cities has been surveyed for goiter.	State wide campaign urging use of iodiostarine tablets each week for school children.
West Virginia	No state survey has been attempted. Several communities have made surveys.	State advocates use of iodin in tablet form and also iodized table salt.
Wisconsin	No state survey has been made. Many localities have examined the school children for goiter.	A pamphlet has been published advising the use of iodin in tablet form for school children and mothers.
Wyoming	No surveys.	No prevention.

While the above tabulation is not as complete as desired, nevertheless it shows, in a general way what is being done in goiter prevention in the United States.

The Plan of Prevention Proposed

It is now generally agreed that simple goiter is in its origin an iodin-deficiency disease, and is therefore a public health as well as a medical problem Because of its high incidence in many states and the fact that it affects both sexes in rural as well as urban districts, a state wide program is proposed. The necessity for a state wide program is also made evident by the failure of the majority of municipalities to undertake without state control, effective measures for its elimination. As a result of this lack of state leadership, cities have adopted various methods of supplying iodin, and in some cities two or more methods are being used, resulting in much confusion and possibly harm. It is believed that a state-wide policy, properly planned and executed, will overcome this situation and bring about more rapid progress in goiter prevention. In such a plan four things are proposed:

1. A state wide survey to determine the incidence of goiter.
2. Iodization of all table salt sold in the state.
3. State wide survey to determine iodin content of water and food supplies.
4. Re-surveys.

Before we can intelligently introduce preventive measures in goiter control, it is necessary to ascertain the incidence of goiter in all sections of the state. This is the only way to determine the efficacy of the method in use. Another important reason for making a thyroid survey, especially among school children, is to determine the character of the thyroid enlargement, whether simple, adenomatous or of the toxic type. Oleson (66) suggests that if such a differentiation were attempted more frequently it would undoubtedly meet the objections of those who claim that benign thyroid enlargements are frequently converted into toxic goiters by the administration of iodin.

The second item of the program calls for the iodization of all table salt sold in the state. This to be accomplished by a general regulation of the State Board of Health. The many things in favor of this method are well summarized by Dr. Olin in an interesting account (71) of the state wide survey of goiter and

the preventive measures undertaken in Michigan. He writes as follows:

> "The survey showed to us the extent of our problem and it suggested the state wide remedy. The unvarying relationship between the percentage of thyroid enlargement and the iodin content of the water supplies have added proof that simple goiter was a nutritional rather than a medical problem. Making good the iodin deficiency in the state's food supply would solve the problem. The question how to do this. Treatment of water supplies was promptly ruled out. This method has been tried and found not entirely effective in several cities. Added to that, it would affect only the cities at best, and our problem was as much rural as urban.
>
> "Chocolate iodin tablets are already in use in the school systems of several cities of Michigan. Their effectiveness is beyond question, but, again, this way of solving the problem applies best to cities with well organized schools and continued educational propaganda among parents. It has the added disadvantage of failing to reach two important groups —the expectant mother and the pre-school child.
>
> "It was clear to us that a condition that was the result of a state-wide food deficiency could best be remedied by supplying that deficiency through an inexpensive and universally used food stuff. Salt was, of course, the logical medium to be chosen, since crude salt commonly contains iodin."

The use of this form of treatment has the advantage of acting on the whole population in goiter districts, beginning at the moment of reproduction and also of acting continuously throughout life, independently of individual endeavor. Marine (51) states "undoubtedly the best method of giving these traces of iodin necessary for goiter prevention is the use of a salt containing .02 to .05 per cent iodin. The statewide use of such a salt both for cooking and table use, would protect all the inhabitants."

Parts three and four of this plan, concerning the iodin survey and resurveys of goiter respectively are necessary for the following reasons: (1) to intelligently study the distribution of goiter within the state, (2) to determine the efficacy of the treatment in use and (3) to act as a guide in modifying the treatment if necessary.

The above plan offers little that is new, nevertheless, it is presented as being the most practical and efficient system for the prevention of simple goiter. Similar programs are proving successful in Switzerland and Austria, where the goiter incidence is high.

SUMMARY

1.—Simple goiter also called common goiter, thyroid enlargement, endemic, epidemic, sporadic, parenchymatous, and colliodal goiter, is now considered an iodin deficiency disease. It has special public health significance because of its high incidence in most countries of the world and especially because of its easy prophylaxis.

2.—The Standards adopted in thyroid surveys have usually been those suggested by Marine and Kimball. They classify the thyroid condition into four groups according to size: (1) normal, (2) slightly enlarged, (3) moderately enlarged, (4) markedly enlarged.

3.—The ratio of the sexes as to goiter varies in different parts of the country, in general however it may be stated that goiter is two or three times more prevalent in females than in males.

4.—There is no racial immunity to goiter.

5.—Seasonal variation in goiter has been traced to the low iodin content of food and water at certain seasons.

6.—There is a lack of authentic information relative to goiter and its influence upon mentality.

7.—The thyroid gland contains a trace of iodin in organic combination which was discovered by Baumann in 1895. This iodin substance (tri-iodo-indo-propionic acid) was identified by Kendall in 1915 and called thyroxin. Iodin composes 65 per cent of thyroxin by weight. Thyroxin isolate in crystalline form possesses the physiologic activity of the thyroid gland itself.

8.—There is a definite relationship between iodin distribution and goiter incidence. Goiter is most prevalent on mountains, plateaus, water divides and inland lake regions and is explained as due to the gradual leaking out of the soil of iodin salts which are very soluble.

9.—Simple goiter can be prevented by the administration of small amounts of iodin. This has been shown by many work-

ers, notably Marine and Kimball in this country and Klinger in Switzerland.

10.—Several methods of administering iodin are in use, namely: (1) sodium iodid per mouth, (2) iodostarine tablets, (3) iodizing public water supplies, (4) iodized salt, (5) sea salt.

11.—The most favored method of giving these traces of iodin necessary for goiter prevention is the use of a salt containing .02 to .05 per cent of iodin.

12.—According to the best information available, there is no danger in iodin prophylaxis when it is carried out intelligently. There is a growing belief that even toxic goiter may be sometimes benefitted by the use of iodin.

13.—Tables and maps showing the distribution of simple goiter in the United States are given. The activities of the various states in the prevention of simple goiter are also tabulated.

14.—A state wide program for the prevention of simple goiter is proposed. This plan provides for: (1) a state wide survey to determine the incidence of goiter, (2) iodization of all table salt sold in the state (3) state wide survey to determine the iodin content of water supplies, (4) Re-surveys.

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